THE USE OF BLAST-FURNACE GASES IN GAS ENGINES.

DURING the past year all the difficulties in the use of blast-furnace gases have successfully been overcome, and it is interesting to consider the rapid progress that has been made in this important development of metallurgical practice. The question was first taken up by Mr. B. H. Thwaite in 1894, and a 15 horse-power engine, worked by blast-furnace gas purified by his apparatus, was set to work at Wishaw, in Scotland, in February 1895. Since that date numerous small motors have been in operation in this country using purified blast-furnace gas driving machinery and dynamos. In the development of large motors and in their adaptation to blowing engines Belgium has taken the lead. In May 1898, Mr. A. Greiner, of the Cockerill Company, described a 200 horse-power engine in successful use at his works. The results attained stimulated experiment in Germany and in Luxemburg. The Cockerill Company, however, continued to take the initiative by starting, on November 2, 1899, the largest gas engine ever built. On May 9, 1900, Mr. Greiner described the engine to the Iron and Steel Institute, and gave the results of six months' working. This was the first gas engine to run the blowing engine of its own furnace. Results of tests of this gas engine, by Prof. Hubert, of Liége, are given in an appendix to an exhaustive paper on power gas and large gas engines, read by Mr. H. A. Humphrey before the Institution of Mechanical Engineers on December 14, 1900. The engine was designed by Mr. Delamare-Deboutteville, and built by the Cockerill Company. It is a single cylinder 600 horse-power engine, working on the Otto cycle, and direct coupled to a double-acting blowing cylinder. The large engine and blower shown by the Cockerill Company at the Paris Exhibition was a duplicate of the one under discussion. It was rated at 700 horse-power on blast-furnace gas, at 800 horse-power on producer gas, and at 1000 horse-power on illuminating gas. In an exhaustive paper on the subject, published by Prof. Joseph W. Richards in the current number of the *Journal* of the Franklin Institute of Philadelphia, the following list of blast-furnace gas engines now in operation is given:—

	No.	Horse-power.
Seraing, Belgium	4	500
Differdingen, Luxemburg	4	500
Hoerde, Westphalia	2	600
	2	1000
Friedenshütte, Silesia	2	200
	2	300
Oberhausen	1	600
Dudelingen	2	600
	2	1000
Kneutingen	2	500
Roechling	1	200
	2	600
Ruhrort	1	500
Barrow, England	—	1000
Toula, near Moscow	3	600
	3	200
Island of Elba	—	1000

The Cockerill Company is now constructing, for the Roechling Ironworks in Lorraine, three 1200 horse-power gas engines. They are double-cylinder tandem engines directly attached by a tail rod to the blowing cylinder. The Cockerill Company and Mr. Delamare-Deboutteville have now decided to build engines of 2500 horse-power. They will have two tandem cylinders on each side of the dynamo, giving four cylinders per engine. They are designed for a central electric station.

In view of the remarkable results already attained, there can be no doubt that during the next few years the design and erection of large central power-stations for the generation and distribution of electric energy in bulk will be one of the most important problems with which engineers will have to deal. The new stations will be larger than any now existing, and every possible effort will be made to reach an unprecedented degree of economy in the production of power. Mr. Humphrey's paper strongly urges the claims of the gas engine to rank as a rival of the steam engine for large power units. The results of a trial of a 400 horse-power Crossley gas engine carried out by Mr. Humphrey are certainly most satisfactory, whilst its capability for continuous work has been shown at Messrs. Brunner, Mond and Co.'s works at Winnington, Cheshire, where it is used for their electrolytic plant. The employment of gas engines in large central station work is, however, still very limited, for out of the total of seven central stations where gas motors are used, the largest has only an aggregate of 650 horse-power, whilst the largest unit is of only 200 horse-power. The use of the waste gases from blast furnaces renders it possible to have a supply of cheap fuel. This result can also, according to Mr. Humphrey, be attained by the use of a Mond producer plant, which is suitable for converting cheap bituminous fuels into suitable gas for gas engines, and at the same time permits of the recovery of the ammonia from the coal as a by-product.

The great industrial revolution which is imminent in the economical utilisation of blast-furnace gases is best shown by the careful calculations made by Prof. Richards of the results that would be attained by the application of this improvement to American blast-furnace practice. As an illustration of average practice, he takes the figures from a blast-furnace plant in Eastern Pennsylvania, which is making in three furnaces 2600 tons of pig iron per week. The composition of the gas by volume is as follows:—

CO_2	CO	H	N
9	27	1·8	62·8

The pig iron produced daily is 370 tons; the fuel used per 100 kilograms of pig iron, 100·0 kilograms; carbon in fuel, 82·9 kilograms: carbon in flux, 4·6 kilograms; carbon in the iron, 3·1 kilograms; efficiency of stoves, 60 per cent.; efficiency of boilers and engines, 4·5 per cent.; pressure of blast, 1·3 kilogrammes per square centimetre (20 lbs. per square inch); and temperature of blast 555° C.

With these conditions, the calculations are as follows:—

Calorific power of gas per cubic metre, 873 calories; volume of gas per 100 kilograms of pig iron, 434·7 cubic metres; calorific effect of gas per 100 kilogrammes of iron, 379,490 calories; heat required to heat blast per 100 kilograms of iron, 90,500 calories; indicated horse-power of engines for blast, 950 horse-power; indicated horse-power of engines for hoist, pumps, &c., per 100 tons of iron daily, 65 horse-power.

From these calculations the following conclusions are arrived at:—

		Calories.
Calorific effect of gases per 100 kg. of pig iron		379,490
Lost (10 per cent.)	37,950	
For heating blast	90,500	
		128,450
Surplus for burning develops		251,040
Surplus per 100 tons of pig iron daily		251,000,000

The horse-power at 100 per cent. efficiency would be 16,400; horse-power with steam at 4½ per cent. efficiency, 738; deficit of steam power per 100 tons of iron daily, 277 horse-power; horse-power with gas engines at 30 per cent. efficiency, 4920; surplus power with gas engines per 100 tons daily, 3900 horse-power; deficit of steam power per 370 tons daily, 1025 horse-power; surplus of gas engine power per 370 tons daily, 14,400 horse-power.

It is an actual fact that at the works considered by Prof. Richards the three blast furnaces are charged with 800 horse-power, furnished to them by the boiler plants fired by coal. It is also a fact that nearly 10,000 horse-power is raised for the rest of the plant by coal-fired boilers, and that all of this could be supplied by gas engines utilising the blast-furnace gases. The saving in the coal bill alone would amount to at least 30,000*l*. in one year. The gas-engine plant to accomplish this would cost 100,000*l*. These calculations, based on average practice, bring out very clearly the great saving of power possible by the economical utilisation of blast-furnace gases.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1901.

THE following prizes are offered by the Paris Academy of Sciences for the year 1901:—

In Geometry, the Francœur Prize (1000 fr.), for discoveries or works useful to the progress of the mathematical sciences, pure or applied; the Poncelet Prize (2000 fr.), with similar conditions; and in Mechanics, the Extraordinary Prize of 6000 francs, for progress tending to increase the efficiency of the French naval forces; the Montyon Prize (700 fr.); the Plumey

Prize (2500 fr.), for improvements in steam engines or any other invention which contributes to the progress of steam navigation; and the Fourneyron Prize (500 fr.), for a theoretical or experimental study of steam turbines.

In Astronomy, the Lalande Prize (540 fr.), for the best work tending to the advancement of astronomy; the Valz Prize (460 fr.), for the most interesting observation during the current year. In Physics, a La Caze Prize (10,000 fr.); the Gaston Planté Prize (3000 fr.), for a discovery, invention or important work in the field of electricity; and the Kastner-Boursault Prize (2000 fr.), for the best work on the applications of electricity in the arts, industry and commerce. In Statistics, a Montyon Prize (500 fr.). In Chemistry, the Jecker Prize, and a La Caze Prize (each of 10,000 fr.), for researches in chemistry. In Mineralogy and Geology, the Delesse Prize (1400 fr.). In Physical Geography, the Gay Prize (2500 fr.), for a study of the distribution of alpine plants in the mountains of the Old World. In Botany, the Bordin Prize (3000 fr.), for a study of the influence of external conditions upon the protoplasm and nucleus in plants; the Desmazières Prize (1600 fr.), for a study of cryptogams; the Montagne Prizes (1000 fr. and 500 fr.), for researches on the anatomy, physiology, description, or development of the lower cryptogams; the Thoré Prize (200 fr.), for the best work on the cellular cryptogams of Europe; the De la Fons Melicocq Prize (900 fr.), for botanical work done in the north of France. In Anatomy and Zoology, the Grand Prize of the Physical Sciences (3000 fr.), for a biological study of the soft water Nematods; the Savigny Prize (1300 fr.), for the assistance of young travelling zoologists.

In Medicine and Surgery, a Montyon Prize; the Barbier Prize (2000 fr.), for a discovery in surgery, medicine or pharmacy of service in the art of healing; the Breant Prize (100,000 fr.), for a specific cure for Asiatic cholera; the Godard Prize (1000 fr.), for work on the anatomy, physiology and pathology of the genito-urinary organs; the Bellion Prize (1400 fr.); the Mège Prize; the Lallemand Prize (1800 fr.), for the encouragement of work on the nervous system; and the Baron Larrey Prize (1000 fr.), for the best work on military medicine, surgery or hygiene. In Physiology, the Pourat Prize (1400 fr.), for experimental work on the cooling due to muscular contraction; a Montyon Prize (750 fr.), and the Philipeaux Prize (890 fr.), for work in experimental physiology; and a La Caze Prize (10,000 fr.).

Among the general prizes offered are the Arago and Lavoisier Medals, the Montyon Prize for unhealthy trades, the Wilde Prize (4000 fr.), the Cahours Prize (3000 fr.), the Tchihatchef Prize (3000 fr.). for Asiatic exploration, the Petit d'Ormoy Prizes (10,000 fr. each), for work in the mathematical or physical sciences, the Leconte Prize (50,000 fr.), for a new and capital discovery in mathematics, physics, chemistry, natural history or medical science, the Jean Reynaud Prize (10,000 fr.), the Saintour Prize (3000 fr.), the Gegner Prize (3800 fr.), the Trémont Prize (1100 fr.), and the Laplace and Rivot Prizes.

Of these prizes, the Lalande, La Caze, Delesse, Desmazières, Leconte and Tchihatchef are expressly stated as being open without distinction of nationality.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. C. T. R. Wilson, F.R.S., Fellow of Sidney Sussex College, has been appointed University Lecturer in Experimental Physics, in succession to Prof. Wilberforce, now of Liverpool. The appointment of Mr. H. Herbert Smith as Gilbey Lecturer in Agriculture has been confirmed by the Senate.

The following awards in Natural Science have been made at the combined examination for entrance scholarships held by ten of the colleges in December, 1900:—

Clare College.—£60, Leather, Bridlington School; £50, Pears, Clifton College; £40, Byatt, Charterhouse; Johnson Exhibition, Jordan, Bedford School.

Trinity Hall.—£40, Hopkins, St. Paul's, and Potts, Kingswood School.

Trinity College.—£80, Chittock, Harrow; £75, Bulleid, Exeter School; £50, Bray, Harrow; Sizarship, Mottram, St. Olave's; £50, Darwin, Marlborough; £40, Browning, Westminster, Chase, Oundle School, and Hodgson, Bedford rammar School.

Pembroke College.—£40, Straus, Harrow.

Gonville and Caius College.—£60, Whitehead, Battersea Grammar School; £70 (Salomons Engineering Scholarship), Brinton, Cheltenham College; £30, Coxon, Shrewsbury School.

King's College,—£80, Spens, Rugby.

Jesus College.—£60, Crawford, Nottingham High School.

Christ's College.—£60, Radice, Bedford Grammar School; £40, Bygrave, Giggleswick School; £30, Dobell, Cheltenham College.

St. John's College.—£60, McDonnell, St. Paul's; £40, Jolly, Framlingham School.

Emmanuel College.—£60, Taylor, King Edward's School, Birmingham; £40, Watkins, Shrewsbury School.

THE ninth jubilee of Glasgow University will be celebrated on June 12-14.

FOR many years a large proportion of the national food supply has been dependent on the preservation of meat and fruit in transport and storage by means of artificial cold, so that the subject of refrigeration is one of great and growing importance to the public. Within the last two years a more special interest has been exhibited in this and kindred subjects by the cheaper and more convenient production of liquid air, the proposed applications of it, and the remarkable scientific discoveries to which it has led. Those of the public who wish for authoritative guidance and clear ideas on the whole subject of refrigeration will shortly have an opportunity of obtaining them placed within their reach. The Technical Education Board of the London County Council, acting in conjunction with the Council of University College, London, have arranged for a series of lectures on the artificial production of cold to be delivered in the chemical theatre of the college in Gower Street by Dr. W. Hampson. The lectures will begin on January 18, at 5.30 p.m., and will be illustrated by experiments. Those who wish to attend, or to obtain a syllabus of the lectures, should apply to the secretary of the college. Young engineers, and others who are engaged in practical work in connection with refrigerating machinery or cold storage, and who have not had the advantage of a systematic training in the physical sciences, should find this a useful opportunity of learning to understand better the connection between their work and the scientific principles involved in it.

THE case of Regina *versus* Cockerton is likely to have a profound effect on our national education. As readers of NATURE may remember, a district auditor, dealing with the accounts of the London School Board, disallowed certain sums paid out of the rates for the teaching of science and art in elementary schools according to the rules of the South Kensington "Directory," as distinguished from those contained in the "Code" of the Education Department. These disallowances were brought before Mr. Justice Wills and Mr. Justice Kennedy in the Queen's Bench Division with a view to having them quashed. But the Court has upheld the view taken by the auditor. The London School Board has been non-suited all along the line. To quote Mr. Justice Wills: "It is not within the power of the Board to provide, at the expense of the ratepayers, science and art schools or classes in day schools; . . . science and art classes in evening continuation schools are as much beyond the scope of rate-aided education as in day schools; but that in both such educational work may be carried on by the School Board provided the whole of the funds required for it are furnished from sources other than contributions from the rates." There is little likelihood that the matter will be allowed to rest here; it is bound to go ultimately to the House of Lords. But, whatever may be found to be the present state of the law, one thing the case makes transparently clear, and that is the chaotic condition of English education. As the *Times* said the other day, "by showing up the existing confusion and to some extent aggravating it, the judgment may perhaps hasten some comprehensive scheme for classifying education in a rational way."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 13, 1900.—"Additional Notes on Boulders and other Rock Specimens from the Newlands Diamond Mines, Griqualand West." By Prof. T. G. Bonney, F.R.S.

Shortly before the outbreak of the war in South Africa, a parcel of specimens from the Newlands Mine, West Griqualand, was sent